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October 7, 1998

Ms. Magalie Roman Salas  
Secretary  
Federal Communications Commission  
1919 M Street, N.W., Room 222  
Washington, D.C. 20054

Dear Ms. Salas:

On behalf of USA Digital Radio Partners, L.P. ("USADR"), enclosed for filing is an original and four copies of a Petition for Rulemaking seeking amendments to Part 73 of the Commission's Rules to permit the introduction of digital radio in the AM and FM bands. Please acknowledge receipt of this filing by providing a date-stamped copy of this letter. Any questions regarding this filing should be directed to the undersigned.

Respectfully submitted,



Robert A. Mazer  
Counsel for USA Digital Radio Partners, L.P.

RAM:dks  
Enclosure

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# **Petition For Rulemaking**

**to the United States Federal Communications Commission  
for In-Band On-Channel Digital Audio Broadcasting**



USA Digital Radio  
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**ORIGINAL**

Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554

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FEDERAL COMMUNICATIONS COMMISSION  
WASHINGTON, D.C. 20554

In the Matter of

Amendment of Part 73 of the  
Commission's Rules To Permit  
the Introduction of Digital Audio  
Broadcasting in the AM  
and FM Broadcast Services

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Docket No. \_\_\_\_\_

**PETITION FOR RULEMAKING**

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Dated: October 7, 1998

## **Executive Summary**

In this Petition for Rulemaking ("Petition"), USA Digital Radio Partners, L.P. ("USADR") requests that the Commission initiate a proceeding to amend Part 73 of the Commission's Rules to permit the introduction of digital audio broadcasting ("DAB") in the AM and FM radio bands. Specifically, USADR seeks modification of the Commission's Rules to permit existing AM and FM licensees to upgrade their analog broadcast transmissions to digital using in-band, on-channel ("IBOC") DAB technology. IBOC DAB technology enables broadcast of analog and digital signals in the broadcaster's existing channel allotment in a manner consistent with the Commission's existing signal interference rules.

USADR was established in 1991 by CBS Radio ("CBS"), Gannett Co., Inc. ("Gannett") and Westinghouse Electric Corporation ("Westinghouse") for the purpose of developing a digital broadcasting system for AM and FM radio. CBS is the general partner of USADR, and its subsidiary, Westinghouse Wireless Solutions Company ("Wireless Solutions"), coordinates the overall technical development work and system design. USADR also is collaborating with outside parties, such as Xetron Corporation and Fraunhofer Institut für Integrierte Schaltungen, as well as a team of broadcast and electrical engineering consultants with expertise in digital communications systems that contribute additional expertise to USADR's development efforts.

IBOC technology provides a means for introducing DAB without the need for new spectrum allocations for the digital signal. There are many forms that an IBOC system might take. The USADR system is designed as an integrated AM and FM IBOC system which provides a comprehensive and flexible transition to an "all-digital" world. USADR has optimized its system to upgrade analog broadcasting by providing greatly enhanced sound

fidelity, improved signal robustness and expanded auxiliary services, which are essentially an upgrade to existing subcarrier services. Although the USADR system is able to achieve the greatest enhancements in its all-digital mode, USADR has used IBOC technology to create a hybrid mode which will allow each AM and FM station to simultaneously broadcast the same programming in analog and digital. By allowing simultaneous broadcasting of analog and digital for all radio programming, this hybrid mode permits a rational transition to an all-digital environment without the need for additional frequency allocations to accommodate the digital signal.

The USADR Petition urges the Commission to immediately initiate a rulemaking proceeding to develop rules for DAB. This rulemaking should culminate with the adoption of rules that allow for the introduction of IBOC DAB in the United States, including the establishment of a DAB transmission standard. More specifically, USADR requests that the Commission take the following regulatory steps to implement IBOC DAB in the United States.

First, the Commission should make a finding that the public interest would be served by the introduction of DAB and that IBOC is the most appropriate means to implement DAB in the United States. USADR demonstrates in this Petition the benefits to the public that will flow from the enhanced audio quality, increased signal robustness and availability of auxiliary services to be offered by DAB. USADR has also shown the viability and advantages of its IBOC DAB approach. IBOC DAB provides a rational transition from analog to digital and offers listeners enhanced service without disruptions to the existing analog radio service or the need for adjustments in consumer patterns of use. IBOC DAB allows this to be achieved without the need for new frequency allocations, the issuance of new licenses or the creation of a new regulatory

structure. Based on this record, USADR believes that the Commission should immediately make a finding that IBOC will be the method of transmission for DAB in the United States.

Second, the Commission should establish interference protection criteria to insure the compatibility of analog and digital radio stations. IBOC DAB must be introduced into the already very complex interference environment which exists today in the AM and FM bands. In order to insure the continued viability of existing analog radio during the transition from analog to digital and simultaneously provide an environment for DAB to prosper, the Commission must develop interference protection criteria. In support of this goal, USADR proposes the adoption of several emission masks

Third, the Commission should establish *ab initio* a transition plan that provides appropriate protection for analog radio for an interim period but also fosters the transition to an all-digital environment. USADR anticipates that the unique features of IBOC DAB will facilitate implementation of a transition plan that avoids much of the complexity and controversy the Commission faced in upgrades of other analog services. Specifically, there is no need for the Commission to establish an end of service date for analog radio. An analog "sunset" is unnecessary because the IBOC DAB signal will occupy the existing analog radio frequency, thereby eliminating the need to reclaim unused analog spectrum. This facilitates a seamless transition from analog to digital. Notwithstanding the benefits of the flexibility of the USADR IBOC DAB system, the Commission will need to establish a minimum number of guidelines to ensure that listeners can obtain the maximum benefits of DAB and that the transition is effective. USADR proposes to immediately allow all broadcasters to begin to transmit both analog and digital signals in a manner consistent with new DAB emission masks. After a twelve year transition period, FM broadcasters would be allowed to increase the power and bandwidth of the

digital carriers. This transition plan establishes a date when analog radio will no longer be protected. At the same time, it ensures the continued viability of analog radio for a limited but reasonable period of time.

Fourth, the Commission should make a finding that it will adopt a DAB transmission standard that will insure that all DAB radios are compatible with all DAB transmitters, enabling the continuation of the current structure of radio in the United States. A government-mandated single standard is required by virtue of the ubiquitous nature of radio, the technical characteristics of IBOC DAB systems, as well as the non-integrated structure of the U.S. radio market. It is only through a standard that the public interest in the development of new digital radio services and maintenance of the universally available existing radio service can be achieved. An economic report prepared on behalf of USADR by Stanley M. Besen and John M. Gale of Charles River Associates, Incorporated, which appears as Appendix B to the Petition, concludes that there exists both an inherent need for a transmission standard and a corresponding lack of obvious private sector mechanisms for the expeditious and coordinated decisionmaking required to fashion such a standard. It further notes that the U.S. radio market requires a standard to ensure compatibility between digital receivers and transmitters, as there is no viable private mechanism to ensure coordination among the various entities that participate in the U.S. radio market, including the diverse interests of radio broadcasting entities, consumers, equipment manufacturers, and other industry participants. This environment significantly handicaps the market's ability to formulate such a standard without government action. USADR therefore urges the Commission to establish a transmission standard for IBOC DAB.

Fifth, the Commission should establish criteria for evaluating IBOC systems and a timetable for the submission of IBOC system information to the Commission for evaluation.

USADR believes that a rulemaking process is the most appropriate mechanism for making decisions regarding interference criteria and DAB transmission standards. A rulemaking process provides each proponent the opportunity to place information on the record pertaining to its system's design and performance. All interested parties, including all proponents, will have an opportunity to comment on this information. Through this process the Commission will be able to develop a sufficient record to make decisions on interference criteria and transmission standards for IBOC DAB.

Finally, the Commission will need to select a single IBOC system to be implemented in the United States and adopt a transmission standard that will allow implementation of the selected system. USADR has submitted substantial material in this Petition demonstrating the technical viability of its system and an appropriate transition plan. The system performance has been confirmed in an independent report prepared by R.L. Pickholtz and B.R. Vojcic of Telecommunication Associates, Inc. which appears in Appendix I. Given the technical capabilities of the USADR system and the inherent advantages of the system for listeners, broadcasters and manufacturers, USADR believes that its system should be the U.S. DAB transmission standard.



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FEDERAL COMMUNICATIONS COMMISSION  
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Amendment of Part 73 of the  
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Broadcasting in the AM  
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Docket No. \_\_\_\_\_

**PETITION FOR RULEMAKING**

USA Digital Radio Partners, L.P. ("USADR"), by its attorneys, hereby submits this Petition for Rulemaking requesting that the Commission initiate a rulemaking proceeding to amend Part 73 of the Commission's Rules to permit the introduction of digital AM and FM radio broadcasting. This Petition asks the Commission to adopt the rules set forth in Appendix A, the procedures outlined below for establishing a digital audio broadcasting ("DAB") system in the United States, and the policies articulated herein. Specifically, USADR seeks modification of the Commission's Rules to permit existing licensees in the AM and FM Radio Broadcast Services to upgrade their analog broadcasts to digital using in-band, on-channel ("IBOC") DAB technology. IBOC allows the simultaneous broadcast of analog and digital signals in the broadcaster's existing channel allotment in a manner consistent with the Commission's existing signal interference rules. Based on the important public benefits to be derived from the introduction of DAB, USADR requests that the Commission expedite its treatment of this Petition.

## I. INTRODUCTION

This rulemaking gives the Commission a unique opportunity to dramatically improve an existing and vital communications service. IBOC DAB will provide the public with enhanced audio quality for both AM and FM radio, increased reliability and new auxiliary services without new spectrum allocations, disruptions in service to the public, or a drain on the Commission's administrative resources. In the past two decades, consumer demand for new and improved services has prompted a conversion from analog to digital in most other communications services. For radio broadcasting, which represents the oldest form of communications technology, a number of decades have passed since the last major innovation -- the introduction of FM stereo in 1961. Now, recent advances in digital technology make it possible for broadcast radio to make the transition to digital using IBOC DAB.

In the last several years, the Commission has seen a dramatic increase in consumer demand for digital products. Consumers have enthusiastically embraced compact discs ("CDs") and are upgrading to digital mobile phones. The conversion to digital in many industries is transforming services offered to the public, and the impact of these new services is evident in many facets of everyday life. Pagers and mobile phones have become relatively ubiquitous and now offer numerous features based on new digital networks. Digital upgrades to wireline telephone networks are facilitating the introduction of services unknown only a few years ago. Digital television holds the promise of vastly improved video images and new ancillary services for the public. The Commission recently authorized the introduction of the satellite-based Digital Audio Radio Service ("DARS"), which has the potential to offer improved sound quality

to the public on a subscription basis. Until now, however, there has been no rational path for satisfying public demand for upgraded AM and FM broadcasting. As USADR demonstrates herein, advances in IBOC technology now provide a solution which will permit AM and FM listeners to enjoy enhanced sound quality, reliability, and service offerings from DAB.

A. The Current Radio Broadcast Industry

Broadcast radio plays a critical role in everyday life, both in the United States and abroad. In fact, radio's role is so pervasive that it is largely taken for granted. It is the primary source of information and entertainment for vast numbers of Americans; providing music, news, weather, traffic and local information in thousands of communities across the country. Furthermore, consumers are able to receive this service virtually everywhere at no cost. Millions of Americans wake up and go to sleep listening to radio. People listen to radio in their homes, in cars, in offices, at the gym, while walking down the street, at the beach, in the park, and in stores.

Radio receivers are one of the most ubiquitous devices in our society. It is estimated that there are over 550 million radio receivers in use today in the United States.<sup>1</sup> Over 70 million new receivers are sold each year.<sup>2</sup> Over 95% of all people over the age of 12 listen to the radio every week.<sup>3</sup> As of August 31, 1998, there were more than 12,300 licensed radio stations.<sup>4</sup> The

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<sup>1</sup> Euromonitor, *World Market for Consumer Electronics* (1997 ed.).

<sup>2</sup> This statistic was provided by the Consumer Electronics Manufacturers Association.

<sup>3</sup> Arbitron, *Radio Today 3* (1997 ed.).

<sup>4</sup> FCC News Release, "Broadcast Station Totals as of August 31, 1998" (released September 11, 1998). There were approximately 4,733 AM stations and 7,632 FM stations. Of these, 1,996 were FM noncommercial educational stations.



average American listens to AM or FM radio more than 22 hours per week.<sup>5</sup> There has been an average annual growth rate of 1.75% in the number of radio stations in the past 17 years,<sup>6</sup> and in 1997, radio station revenues were \$12.3 billion, up 9.3% from \$11.2 billion in 1996.<sup>7</sup>

There are a number of fundamental aspects of radio broadcasting which define this service. Radio broadcasts are free; the consumer does not need a subscription and is not charged a fee. As a result, radio's penetration is unrivaled by other services. Radio is inherently local because coverage is limited. In turn, radio provides one of the best sources of local information and, to a large extent, reflects the tastes, values and interests of the local community each station serves. Moreover, even though individual radio broadcasts are inherently local, radio broadcast availability is presumed to be universal. Anyone driving from coast to coast expects to be able to receive radio broadcasts, using the same receiver, throughout the country. Another important aspect of radio is the relatively low cost of receivers. Although audiophiles can spend considerable sums on a high-end receiver, radio can also serve the listener who can only afford a basic portable or clock radio. In addition, radio's role in society goes beyond entertainment. Radio provides critical public service as a central part of the Emergency Alert System, as a primary means of dissemination of political news and information, and as a source for public service announcements.

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<sup>5</sup> Arbitron, *Radio Today* 3 (1997 ed.).

<sup>6</sup> BIA Research, Inc., *State of the Radio Industry* 19 (1998).

<sup>7</sup> *Id.* at 32.

Although radio continues to be a strong medium, there is consumer demand for improved service and enhanced audio quality. Unfortunately, limitations inherent in today's analog broadcasting restrict options for improving AM and FM performance. These limitations have had a greater impact on AM than FM. On average, across all Arbitron markets, AM stations capture only 18% of local commercial share.<sup>8</sup> Because AM is not able to provide high quality sound, AM has become extremely dependent on news, talk and sports programming. Although many AM stations are extremely successful, other AM stations have been frustrated in their ability to meet listener requirements. At least one industry analysis recently noted:

unless revived by technological innovations such as digital or unique, high-demand niche programming, the weaker AMs will continue to languish.<sup>9</sup>

Changes in listener expectations have been fueled, in part, by improvements in pre-recorded music and new digital broadcast services. Digital CDs and tapes offer superior audio quality when compared to analog AM and FM radio. Listeners now have the option to obtain cable or broadcast satellite delivery of music to their home, to download music from the Internet and, in a few years, may be able to receive high quality digital audio from satellite DARS.

IBOC DAB provides a means to preserve the special role broadcast radio plays in American life by allowing radio to meet the higher sound quality the public demands. Because radio is local and provides vital information and entertainment at no cost to large numbers of people, its role in society cannot be overstated. Yet, to the extent radio remains analog, the FCC

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<sup>8</sup> *Id.* at 20 (Figure 2) and 21. This contrasts with an average 38% audience rating in 1983.

<sup>9</sup> *Id.* at 21.

will miss an opportunity to authorize enhanced services which better meet public needs. DAB can upgrade existing radio, lay the foundation for the introduction of new digital services and, at the same time, help preserve radio's role in American life.

B. Overview of IBOC Technology

IBOC technology provides a means for introducing DAB without the need for new spectrum allocations for the digital signal. There are many forms that an IBOC system might take. The USADR system is designed as an integrated AM and FM IBOC system which provides a comprehensive and flexible transition to an "all-digital" world.<sup>10</sup> USADR has optimized its system to upgrade analog broadcasting by providing greatly enhanced sound fidelity, improved signal robustness and expanded auxiliary services, which are essentially an upgrade to existing subcarrier services. Although the USADR system is able to achieve the greatest enhancements in its all-digital mode, USADR has used IBOC technology to create a hybrid mode which will allow each AM and FM station to simultaneously broadcast the same programming in analog and digital. By allowing simultaneous broadcasting of analog and digital for all radio programming, this hybrid mode permits a rational transition to an all-digital environment without the need for additional frequency allocations to accommodate the digital signal.

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<sup>10</sup> USADR uses the term "hybrid mode" to refer to operation of the IBOC DAB system with both an analog and digital signal. "All-digital mode" refers to operation of the system without the analog signal. These modes of operation are described in greater detail below in Sections VI [FM] and VII [AM]. USADR also discusses an "interim hybrid phase" or "hybrid period" when FM and AM stations may operate in the hybrid mode. This permits stations to introduce a digital signal, but ensures protection for analog broadcasts. The "all-digital period" refers to the time in the future when stations will no longer be obligated to protect analog broadcasting.

The USADR IBOC DAB system consists of digital signals broadcast in the frequency assigned to an existing AM or FM radio station ("in-band"). Because the digital signal is placed with the emissions "mask" established for analog broadcasts ("on-channel"),<sup>11</sup> it can be transmitted simultaneously with the existing analog signal (the "host" signal). Because IBOC DAB simultaneously supports both analog and digital broadcasting in the hybrid mode, it permits a rational transition to digital.

In the hybrid mode, the digital signal is broadcast at somewhat reduced power levels from those used in the all-digital mode in order to accommodate the analog broadcast. Nonetheless, the improved sound quality, reliability and coverage of both the analog and digital signals in the hybrid mode will immediately provide the listening public with greatly enhanced service. Moreover, the hybrid mode will support new auxiliary services which will upgrade existing subcarrier services. These auxiliary services will be expanded in the all-digital mode of operations.

Developing IBOC requires a number of technical tradeoffs to ensure a system that optimizes benefits to the public. The audio quality, coverage and robustness must all be considered in system development. Without proper tradeoffs, an IBOC system will be excessively disruptive to the broadcast environment. However, if optimized, the radio industry and public will benefit from an IBOC system without new frequency allocations, without changes in the public's ability to find a favorite radio station on the dial, without requiring an immediate upgrade of all radio receivers and without disruption in service to the public.

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<sup>11</sup> See 47 C.F.R. §§ 73.44 and 73.317.

C. Requested Rulemaking

In this Petition, USADR proposes that the Commission adopt the following policies and specific amendments to Part 73 of the Commission's Rules that are necessary to manage the transition from analog to digital broadcasting.

First, USADR demonstrates in this Petition for Rulemaking the significant advantages of IBOC and IBOC's technical viability. It therefore urges the Commission to immediately make a finding that the public interest will be served by the introduction of digital radio and that IBOC will be the method for introducing DAB in the United States.

Second, USADR believes that a government-mandated transmission standard is necessary to ensure a prompt and orderly transition to digital. Thus, it urges the Commission to make a finding that a transmission standard is necessary to promote the development of DAB and to provide listeners the maximum benefit of DAB. The standard should include all of the technical elements of the IBOC DAB system necessary to ensure universal operability of receivers. As part of the standard-setting process, USADR urges the Commission to develop criteria and specify procedures for evaluating proposed IBOC DAB systems.

Finally, USADR asks the Commission to adopt a transition plan as proposed in Section IX below. Under this proposal, broadcasters will be able to immediately adopt hybrid IBOC DAB. In order to insure that the new digital signal does not harm existing analog service, USADR proposes that the Commission adopt separate AM and FM composite analog/digital emissions masks for hybrid IBOC DAB. After a twelve year transition period, analog broadcasts would no longer be protected. In the case of FM, a new all-digital mask would become effective

at that time. The new FM all-digital emissions mask would allow the broadcaster to increase the power and bandwidth of the digital sidebands. In the case of AM, the all-digital signal will fit within the composite AM mask adopted for the interim hybrid period.<sup>12</sup>

USADR urges the Commission to adopt these proposals as the best means to protect analog broadcasters and listeners and simultaneously promote the development of DAB.

## **II. BACKGROUND ON USADR**

### **A. USADR Development Partners**

USADR was established in 1991 by CBS Radio ("CBS"), Gannett Co., Inc. ("Gannett") and Westinghouse Electric Corporation ("Westinghouse") for the purpose of developing a digital broadcasting system for AM and FM radio.<sup>13</sup> At that time, USADR invented the IBOC DAB concept and began its system development work. Since 1991, USADR has become synonymous with IBOC DAB. Today, USADR's development efforts draw on the resources of a diversified team of scientists and engineers representing major broadcasters, electronics equipment manufacturers and research universities. CBS is the general partner of USADR, and its subsidiary, Westinghouse Wireless Solutions Company ("Wireless Solutions"), coordinates the overall technical development work and system design. Wireless Solutions currently employs approximately 20 scientists and engineers devoted to the development of the USADR IBOC

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<sup>12</sup> In the event the Commission adopts rules which permit broadcasters to adopt the all-digital mode before the end of the twelve year transition period, the USADR system would permit early adoption of the AM all-digital mode.

<sup>13</sup> CBS Radio's parent company and Westinghouse merged in 1996. The surviving company maintains the CBS name. CBS and Gannett remain the owners of USADR.

DAB system. USADR also is collaborating with outside parties that contribute additional expertise to USADR's development efforts. Xetron Corporation ("Xetron"), a former Westinghouse subsidiary and now a subsidiary of Northrop Grumman Corporation, provides USADR with technical support for the development and testing of the AM components of the USADR system. Xetron is a premier developer of sophisticated electronic communications systems and has secured numerous patents in signal processing, filtering and interference cancellation. Fraunhofer Institut für Integrierte Schaltungen ("Fraunhofer"), the recognized leader in audio compression technology and psycho-acoustics, coordinates the audio compression development work for the USADR system and has provided critical integration of the MPEG Advanced Audio Coding ("AAC") codec for USADR's system. Fraunhofer is the leading organization of applied research in Germany and operates 47 research institutes with approximately 4,500 scientists and engineers. Fraunhofer had a leading role developing the most advanced audio coding schemes, several of which have been designated as worldwide standards, such as MPEG Layer - 3 and MPEG AAC.<sup>14</sup> USADR's efforts also are supported by a team of broadcast and electrical engineering consultants with expertise in digital communications systems.<sup>15</sup>

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<sup>14</sup> Additional background information on Xetron and Fraunhofer is contained in Appendix M.

<sup>15</sup> Appendix I contains a report by R.L. Pickholtz and B.R. Vojcic of Telecommunications Associates, Inc., which has provided an independent analysis and verification of the USADR system. Appendix G, prepared by Glen Clark & Associates and duTreil, Lunden & Rackley, Inc., contains a technical report on the existing interference environment and the potential impact of the USADR IBOC DAB system on the AM band. Appendix D, prepared by Moffet, Larson & Johnson, Inc., contains a technical report on the existing interference environment of the FM band.

As established broadcasters, USADR's parent companies have provided critical assistance tailoring USADR's efforts to maximize the benefits of DAB for broadcasters and the listening public. CBS media properties include CBS Radio, with more than 160 owned and operated stations; the CBS Television Network; 14 owned and operated television stations; CBS Cable; CBS Enterprises, a leading first-run and off-network programming unit; and TDI Worldwide, Inc., one of the nation's largest diversified out-of-home media companies. In addition, CBS has an interest in Westwood One, the largest producer and distributor of news, talk, sports and entertainment radio programming in the United States. Gannett is a diversified news and information company that publishes newspapers, operates broadcasting stations (including 21 television stations) and cable television systems, and is engaged in research, marketing, commercial printing, newswire services, data services, and news programming. Gannett also owns the nation's largest newspaper group in terms of circulation. The company's 84 daily newspapers, including USA TODAY, have a combined daily paid circulation of approximately 6.7 million.

B. Development History

In the initial stages of developing its system, USADR quickly rejected the options for terrestrial DAB systems outside the AM and FM bands, concluding that these systems were impractical due to a lack of available spectrum and the need for systems to work within the existing radio broadcast infrastructure. Non-IBOC proposals for terrestrial digital radio remain as impractical today as they were seven years ago for the same reasons. USADR has spent



considerable time and resources since 1991 developing a system that is practical and presents few regulatory or administrative hurdles.

Unlike television, radio is inherently a mobile technology. Thus, any digital radio solution must be able to deliver high performance levels for the fixed user in a home or office, as well as the mobile user in a car or listening to a portable radio. In addition, unlike digital systems designed for voice communications, radio must deliver high sound fidelity to meet the listening needs of the public.

During its first few years, USADR built prototype AM and FM systems which were designed to test the viability of IBOC. From 1992 to 1995, USADR operated experimental IBOC DAB systems in Cincinnati, Las Vegas, New Orleans, Chicago, Los Angeles, Monterey and Urbana, Illinois. These experimental stations demonstrated a digital signal could be simulcast with the host analog signal without affecting the integrity of either broadcast. USADR used these test results and subsequent studies to more fully understand the current interference environment in the AM and FM bands and the technical options available to meet the needs of the listening public.

In 1996, USADR initiated the final design phase for its operational system. USADR has established a dedicated DAB laboratory in Columbia, Maryland where it is in the final stages of its design and implementation work. USADR has characterized the AM and FM bands, used that information to re-engineer its prototype systems, and has designed an integrated AM and FM system which meets all the design goals established at USADR's inception. It is currently conducting tests using experimental stations in Columbia and Bethesda, Maryland and